From: Praskins, Wayne
To: Robinson, Derek J CIV USN NAVFAC SW SAN CA (USA)
Cc: Stoick, Paul T CIV USN NAVFAC SW SAN CA (USA); Hays, David C Jr CIV USARMY CENWK (USA)
Subject: EPA building RG calculations
Date: Thursday, July 15, 2021 9:09:16 PM
Attachments: HPNS USN review version Total and ingestion risk.xlsx
HPNS USN review version external risk calcs.xlsx

Derek –

Attached are two spreadsheets providing our current cancer risk calculations associated with the HPNS radiological building RGs. The spreadsheets are not final; they are still undergoing internal review. The first spreadsheet provides risk estimates for the ingestion pathway (i.e., the removable fraction); the second spreadsheet provides risk estimates for the external pathway. The risk estimates are described as "bounding" estimates to reflect the conservative assumptions made in the calculations.

Risk via ingestion pathway

The ingestion calculations assume a contaminated surface area of 32 m2. The calculations account for decay over the 26-year exposure period and daughter concentrations where appropriate (using +D DCFPAK slope factors). To be more protective and account for higher child ingestion rates, we have apportioned the ingested amount over the exposure period using 95th percentile values from the EPA Exposure Factors Handbook (Table 5-33) and the BPRG calculator 16 hours/day exposure assumption. This results in ingestion of virtually all of the contamination in the first 5 to 8 years of exposure. Even with these conservative assumptions, the ingestion risk associated with each of the 11 radionuclides is within the EPA risk range (< 1 x 10-4).

The Navy's April submittal calculates ingestion risk in a two-step process by applying dose conversion and cancer slope factors to RESRAD BUILD dose estimates. The submittal assumes decay and ingrowth, a larger contaminated area (43 v 32 m2), and a uniform rate of ingestion over the 26-year exposure period.

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Risk via external pathway

The external calculations use EPA's online BPRG calculator (decay and ingrowth accounted for) with the outputs adjusted to reflect contamination on the floor and lower walls. The adjustment factors were provided by Oak Ridge National Laboratory. We calculated risks for three different receptor locations within a room and included the highest exposure scenario (receptor positioned in the corner) in the summary tab. Other inputs are listed in the spreadsheet (e.g., concrete surfaces, 10 x 10' room). We chose to set the amount of time spent indoors equal to one after considering the 95th percentile "time indoors" values in Table 16-1 in the Exposures Factor Handbook. (Using actual values from Table 16-1 would provide an average value slightly less than one but the difference is small.)

The Navy's April submittal calculates external risk by applying dose conversion and slope factors to RESRAD BUILD dose estimates. The submittal uses lower values than EPA assumed for the amount of time spent indoors, in part because mean rather than 95th percentile values were used. The submittal accounts for radiation decay and ingrowth, and assumes that a receptor would be positioned in the center of the room. The submittal also assumes contaminated floor and lower walls with a slightly larger room size (12' x 12').

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Total risk

The first tab in the ingestion spreadsheet provides the sum of the risks for the two exposure pathways. The total is less than 1 x 10-4 for most radionuclides; the exceptions are Cs-137, Co-60, and the two europium isotopes.

Here is a portion of the summary table included in the spreadsheet, providing estimated cancer risks for each radionuclide if present at the RG:

Parent ROC	Bounding Ingestion Risk	Bounding External Risk	Bounding Total Risk
^{241}Am	5.29E-06	2.89E-07	5.6E-06
^{60}Co	5.14E-05	2.01E-04	2.5E-04
^{137}Cs	6.06E-05	1.37E-04	2.0E-04
^{152}Eu	2.05E-05	2.13E-04	2.3E-04
^{154}Eu	3.51E-05	1.71E-04	2.1E-04
^{3}H	1.26E-07	0.00E+00	1.3E-07
^{239}Pu	6.57E-06	4.14E-09	6.6E-06
^{226}Ra	1.95E-05	1.17E-05	3.1E-05
^{90}Sr	3.84E-05	2.34E-06	4.1E-05
^{232}Th	2.28E-05	5.81E-06	2.9E-05
^{235}U	2.08E-05	8.36E-06	2.9E-05

Two key assumptions that would need to be verified during retesting are the removable fraction (< 20%) and the extent of contamination (< 32 m2). We are still wrestling with how the latter assumption would be verified, particularly the minimum MDAs needed to verify that an area greater than 32 m2 is not contaminated and contributing significant risk.

Please let me know if you would like to set up a time to discuss.

Wayne Praskins | Superfund Project Manager
U.S. Environmental Protection Agency Region 9
75 Hawthorne St. (SFD-7-3)
San Francisco, CA 94105
415-972-3181